provision of such channels, for example in the front region of the absorbent core/structure, and/or in the crotch region of the absorbent core/structure, a diaper of increased flexibility can be provided, whilst surprisingly maintaining its performance throughout its use.

As the functionality of the absorbent core is changed to improve, e.g. absorbency, fit, or reduced cost, the performance and/or appearance of the article may be affected negatively. Efforts can be made to modify the article or parts of the article in order to provide them with a particular appearance. In some examples, the article may be modified to communicate or signal to the caregiver that the channels exist in the absorbent core of the article, and that the channels are there to create faster and more efficient liquid absorbency. Such signalling or communication may be done, for example, via exterior graphics and/or interior printed adhesives. As such, there is a need for improved absorbent articles comprising absorbent cores with channels that exhibit excellent performance and that are aesthetically pleasing.

SUMMARY OF THE INVENTION

Absorbent articles herein may provide a topsheet, a backsheet, an absorbent core disposed between the topsheet and the backsheet, characterized in that the absorbent core comprises a first supporting sheet (16), a second supporting sheet (16') and an absorbent layer (17) comprising an absorbent material (50) that comprises superabsorbent polymer material and is free of cellulosic material; wherein the absorbent layer comprises channels that are substantially free of the superabsorbent polymer material; wherein the first supporting sheet and the second supporting sheet are bonded through the channels, and wherein graphics are printed on the backsheet and the graphics approximate the shape and contours of the channels.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a plan view of a diaper in accordance with one non-limiting embodiment.

Figure 2A shows a perspective view of an absorbent structure in accordance with one non-limiting embodiment.

Figure 2B shows a perspective view of an alternative absorbent layer in accordance with one non-limiting embodiment.

Figure 2C shows a perspective view of an absorbent structure that may be combined with the absorbent structure in accordance with one non-limiting embodiment.

Figure 3A shows a perspective view of an alternative absorbent layer in accordance with one non-limiting embodiment.

Figure 4A shows a perspective view of an alternative absorbent layer in accordance with one non-limiting embodiment.

Figure 4B shows a perspective view of an alternative absorbent layer in accordance with one non-limiting embodiment.

Figure 5 shows a cross sectional view of an absorbent core not in accordance with ~~one non-limiting embodiment~~ the invention.

Figure 6 shows a cross sectional view of an alternative absorbent core not in accordance with the invention~~one non-limiting embodiment~~.

Figure 7 shows a cross sectional view of an alternative absorbent core in accordance with one non-limiting embodiment.

Figure 8 shows a cross sectional view of an alternative absorbent core not in accordance with the invention~~one non-limiting embodiment~~.

Figure 9 shows a cross sectional view of an alternative absorbent core not in accordance with the invention~~one non-limiting embodiment~~.

Figure 10 shows a cross sectional view of an alternative absorbent core not in accordance with the invention ~~one non-limiting embodiment~~.

Figure 11 shows a cross sectional view of an alternative absorbent core not in accordance with the invention ~~one non-limiting embodiment~~.

Figure 12 shows a cross sectional view of an alternative absorbent core not in accordance with ~~the~~ the invention~~one non-limiting embodiment~~.

Figure 13 shows a cross sectional view of an alternative absorbent core in accordance with one non-limiting embodiment.

Figure 14 shows a method/ apparatus of forming an absorbent core in accordance with one non-limiting embodiment comprising two absorbent structures of the disclosure.

Figure 15 and 16 show plan views of non-limiting embodiments of an absorbent article of the present invention comprising backsheet graphics.

Figures 17A, 17B, 17C, and 18 show top view representations of non-limiting embodiments of printed adhesive patterns.

Fig. 19 shows a plan view of backsheet graphics that approximate the shape and contours of the channels.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

"Absorbent article" refers to a device that absorbs and contains body exudates, and, more specifically, refers to devices that are placed against or in proximity to the body of the wearer to times) its weight of a 0.9% saline solution in de-mineralized water as measured using the Centrifuge Retention Capacity test (Edana 441.2-01).

"Nonwoven material" as used herein refers to a manufactured web of directionally or randomly orientated fibers, excluding paper and products which are woven, knitted, tufted, stitch-bonded incorporating binding yarns or filaments, or felted by wet-milling, whether or not additionally needled. Nonwoven materials and processes for making them are known in the art. Generally, processes for making nonwoven materials comprise laying fibers onto a forming surface, which may comprise spunlaying, meltblowing, carding, airlaying, wetlaying, coform and combinations thereof. The fibers may be of natural or man-made origin and may be staple fibers or continuous filaments or be formed in situ.

"Visible" as used herein means capable of being perceived by the unaided human eye.

Absorbent structure (13) with channels

The present invention provides absorbent articles with absorbent cores comprising channels and printed signals that communicate the channels.

The absorbent structure (13) herein may comprise a first supporting sheet (16) a second supporting sheet (16') with an absorbent layer (17) of absorbent material (50). The absorbent material (50) comprises at least a superabsorbent polymer material and is free of cellulosic material~~optionally a cellulosic material, such as a cellulose, e.g. pulp, or modified cellulose~~.

The absorbent structure (13) may also comprise one or more adhesive material(s), further described below. In one embodiment, the absorbent layer (17) is three dimensional and comprises a first substantially longitudinal channel (26) and a second substantially longitudinal channel (26) that are substantially free of said superabsorbent polymer material. Other materials may be present in said channels (26), as further described below, for example said one or more adhesive material(s) (40; 60).

The absorbent structure (13) and the absorbent layer (17) may each have a longitudinal dimension and average length L, e.g. extending in the longitudinal dimension of the structure or layer and a transverse dimension and average width W, e.g. extending in the transverse dimension of the structure or layer. The absorbent structure (13) and the absorbent layer (17) may each have a front region, being in use towards the front of the user, back region, being in use towards the back of the user, and therein between a crotch region, each extending the full transverse width of the structure/ layer, and each having 1/3 of the average length of the structure/ layer.

The absorbent structure (13) and the absorbent layer (17) may each possess a central longitudinal axis X, a central transverse axis Y perpendicular to said central longitudinal axis X; said absorbent layer (17) and said absorbent structure (13) may have each a pair of opposing longitudinal side edges extending in the longitudinal dimension of the structure or layer and a pair of opposing transverse edges (19) , e.g. front transverse edge being in use towards the front of a user (wearer), and a back transverse edge being in use towards the back of a user. The longitudinal side edges (18) and/ or transverse edges (19) of the absorbent structure (13) or absorbent layer (17) may be parallel respectively to the central longitudinal axis and/ or central transverse axis respectively or one or more may be curvilinear, and for instance provide for a narrower transverse dimension in the crotch region. Typically the longitudinal side edges are mirror images of one another in the longitudinal X-axis.

In one embodiment, the central longitudinal X-axis of the absorbent layer (17) delimits first and second longitudinal side portions (20) of the absorbent layer (17), respectively, referred herein as longitudinal side portions (20). Each of said longitudinal side portions may thus be present in said front region, crotch region and back region, and hence, there is a first longitudinal portion's front region, and a second longitudinal portion's front region etc. In some embodiments herein, said longitudinal portions of the absorbent layer (17) are mirror images of one another in the X-axis of the layer.

The absorbent layer (17) comprises at least a first channel (26) and second channel (26) that are substantially free of (e.g. free of) said superabsorbent polymer particles, and said channels (26) may extend through the thickness (height) of the absorbent layer (17). (It should be understood that, accidentally, a small, negligible amount of superabsorbent polymer particles may be present in the channel, which does not contribute to the overall functionality). ~~When the absorbent layer (17) comprises cellulosic or cellulose, in some embodiments the said first and second channels (26) are also free of such cellulosic / cellulose material.~~

The first channel (26) may be present in said first longitudinal side portion of the absorbent layer (17) and the second channel (26) may be present in said second longitudinal side portion of the absorbent layer (17).

The first and second channel (26) may each extend substantially longitudinally, which means typically that each channel (26) extends more in the longitudinal dimension than in the transverse

dimension, and typically at least twice as much in the longitudinal dimension than in the transverse dimension.

Thus, this includes channels (26) that are completely longitudinal and parallel to the longitudinal direction of said absorbent layer (17) (i.e. paralleled to said longitudinal-axis); and this includes channels (26) that may be curved, provided the radius of curvature is typically at least equal (optionally at least 1.5 or at least 2.0 times this average transverse dimension) to the average transverse dimension of the absorbent layer; and this includes channels (26) that are straight but under an angle of (e.g. from 5°) up to 30°, or for example up to 20°, or up to 10° with a line parallel to the longitudinal axis. This may also include channels with an angle therein, provided said angle between two parts of a channel is at least 120°, at least 150°; and in any of these cases, provided the longitudinal extension of the channel is more than the transverse extension.

In some embodiments, there may be no completely or substantially transverse channels present in at least said crotch region, or no such channels at all.

Each of said first and second channels (26) may have an average width W' that is least 4% of the average width W of said absorbent layer (17), or for example W' is at least 7% of W; and/ or for example and up to 25% of W, or up to 15% of W; and/ or for example at least 5 mm; and for example up to 25 mm, or for example up to 15 mm.

Each of said first and second channels (26) may have an average length L' which may for example be up to 80% of the average length L of said absorbent layer (17); if the channels (26) are only in the front region, or only in the crotch region, or only in the back region, L' is for example up to 25% of L, or up to 20% of L, and/ or L' is for example at least 5% of L, or at least 10% of L; and/ or L' is for example at least 10 mm, or at least 20 mm; if the channels (26) extend in said crotch region and front region, and optionally the back region, L' is for example up to 80% of L, or up to 70% of L, and/ or L' is for example at least 40% of L, or at least 50% of L. In case the channel is not parallel to the longitudinal axis, the length L' of the channel is the length as measured by projection against the longitudinal axis.

The channels (26) are ~~may typically be~~ so-called "permanent" channels (26). By permanent, it is meant that the integrity of the channels (26) is at least partially maintained both in the dry state and in the wet state, including during friction by the wearer thereon. The Wet Channel Integrity Test described below can be used to test if channels are permanent following wet saturation and to what extent.

Permanent channels (26) may be obtained by provision of one or more adhesive material that immobilize said absorbent material (50), and/ or said channels (26), e.g. or said absorbent layer (17), and/ or that immobilize said supporting sheet (16) into said channels (26), or part thereof. Disclosed herein, ~~The~~ absorbent cores (7) ~~may~~ comprise ~~in particular~~ permanent channels formed by bonding of the first supporting sheet (16) and second supporting sheet (16') through the channels, as exemplarily shown in Fig. 7 and Fig. 13 for example. Typically, glue may be used to bond both supporting sheets throught the channel, but it is possible to bond via other known means, for example ultrasonic bonding, or heat bonding. The supporting layers can be continuously bonded or intermittently bonded along the channels.

Indeed, the inventors observed that such channels provide for fast liquid acquisition which reduces risk of leakages. The permanent channels help to avoid saturation of the absorbent layer in the region of fluid discharge (such saturation increases the risk of leakages). Furthermore, the inventors surprisingly found that, in contrast to what would be expected, whilst decreasing the overall amount of superabsorbent polymer material in the absorbent structure is reduced (by providing channels free of such material), the fluid handling properties of the absorbent structure, or diaper, are improved. Permanent channels, also have the further advantages that in wet state the absorbent material cannot move within the core and remains in its intended position, thus providing better fit and fluid absorption.

For example, the inventors have compared the amount of AGM loss in a wet state according to the WAIIT test for a core having two absorbent layers with permanent channels as shown in Fig. 4A relative to a similar core with same amount of AGM and glue but having no channels .

In short, the WAIIT test determines the amount of non-immobilized absorbent particulate material amount in the cores in wet conditions. In this test, the absorbent core is wet to 73% capacity and is cut in its middle in the transversal direction and left to fall from a pre-determined height and loss of material is measured. Further information regarding the test can be found in US 2008/0312622 A1.

The results were that the core had a Wet Immobilization of 87 % (StDev = 5%) of AGM compared to a Wet Immobilization of 65% (StDev = 5%) for the comparative core without channels. In this example the channels were made permanent by adhesive bonding of the two supporting sheets in the channels using two layers of thermoplastic fibrous adhesive (Fuller 1151 applied twice at 5 gsm) and one layer of hotmelt adhesive (Fuller 1358 applied at 5 gsm).

latter may optionally extend into the front region and/ or back region, with any of applicable dimensions and other characteristics described above. Optionally, further channel(s) may be present in the back region, for example two, such as for example shown in Figure 4B.

The first and second channels (26), and optionally further channels (26), may be positioned in said absorbent layer (17) such that there is a central longitudinal strip, coinciding with said longitudinal axis, which is free of any channels (26) ; said absorbent material (50) may be substantially continuously present in said strip. For example, said strip may have a minimum width D of at least 5% of W, or at least 10% of W, and/ or for example at least 5 mm, or at least 10 mm or at least 15 mm, and/ or even up to 40 mm.

In some embodiments, in said central longitudinal strip between two neighboring channels (26) the average basis weight of absorbent material (50), or of said superabsorbent polymer material, is at least 350, and for example up to 1000 grams per m^2, or for example from 450 grams per m^2, and for example up to 750 grams per m^2.

In some embodiments, adjacent each first and second channel, and optionally adjacent said further channel(s), said absorbent material (50) is substantially continuously present.

The absorbent structure (13) typically comprises one or more further material(s) (e.g. a further material layer) to cover the absorbent layer (17), herein referred to as further material; the further material may be a layer comprising adhesive, for example on the surface that is to contact the absorbent layer (17) of the absorbent structure (13) herein. Thus, the further material may comprise, on the surface to be placed adjacent said absorbent layer (17) of the absorbent structure (13), an adhesive material.

The resulting structure is herein referred to as "absorbent core (7)". Examples thereof are shown in Figures 5 to 13.

This further material may be a further absorbent structure (13'), with a second absorbent layer (17') and ~~a~~ the second supporting sheet (16'), so that both absorbent layers (17, 17') are sandwiched between said supporting sheets (16; 16'); this may be a further absorbent structure (13') of the disclosure, with two or more channels (26') as described herein, and for example shown in Figures 5, 6, 7, 8; or this may be a absorbent structure as described herein but without channels, such as for example shown in Figure 9; and/ or it may be an absorbent structure as described herein but without adhesive.

The second absorbent structure (13') may be identical to the first absorbent structure (13), or they may both be absorbent structure with channels (26; 26') of the disclosure, but they may be different, for example having different channels, different number of channels (such as for example shown in Figure 8), different adhesive, different adhesive application or combinations thereof.

The channels (26), or some of those, of the first absorbent structure (13) and the channels (26') of the second absorbent structure (13'), or some of those, may coincide and overlap with one another; e.g. completely or for example coincide only partially and overlap only partially; or some or all of the channels (26; 26') may even not coincide and not overlap one another. In some embodiments they are about identical to one another and the channels (26) of one structure substantially completely coincide and overlap the channels (26) of another structure. This is for example shown in Figure 12.

In some embodiments, the further material may be a part of the supporting sheet (16), which is folded over the absorbent layer (17) and then sealed along the peripheral edges, to enclose the absorbent layer (17).

In some embodiments, the further material is the~~a~~ further supporting sheet (16'), i.e. the absorbent structure (13) is covered with the~~a~~ further supporting sheet (16'), said absorbent layer then being sandwiched between the two supporting sheets.

In some embodiments, the further material may be an acquisition material layer (70) and/or an acquisition sheet (12), for example sealed to said supporting sheet (16). In some embodiments, the further material includes a further absorbent structure, e.g. any of those described above, or the further supporting sheet (16'), and then combined with an acquisition material layer (70), and optionally a further acquisition sheet (12). This is for example shown in Figure 11.

The further material may also be an acquisition material layer (70) present adjacent said absorbent layer (17), the acquisition material layer (70) optionally comprising chemically cross-linked cellulosic fibers, and the acquisition material layer being supported on a second supporting sheet (16'). The absorbent layer (17) and the acquisition material layer (70) may then be sandwiched between said supporting sheet (16) of the first structure and said second supporting sheet (16'), as exemplary shown in Fig. 12. The acquisition material layer (70) may also further comprise channels (26'), in particular substantially completely overlapping with the channels (26) of said first absorbent structure (13) as shown in Fig. 13.

The supporting sheet (16) of the first structure and/or the second supporting sheet (16') of the acquisition material layer (70) may fold into the channels (26) of the first absorbent structure (13) and/or optionally into the channels (26') of the acquisition material layer (70), if present, or part of these channels (26 ,26'). The one or more adhesive material(s) may be at least present in the channels (26') of the adjacent absorbent structure (13'). The resulting absorbent core (7) is then a laminate of absorbent structures (13'; 13') with channels (26; 26'), wherein the channels (26;26') extend substantially through the thickness of the absorbent layers (17;17'). This is for example shown in Figure 12.

In addition or alternatively, it may be that one or two, or more, or all, channels (26) of one absorbent structure (13) do not superpose the channels (26') of the adjacent absorbent structure (13'); they may for example be complementary with the channels (26) of the adjacent structure. By complementary it is meant that the channels (26') of the second absorbent structure (13') form an extension of the channels (26) of the first absorbent structure (13).

In some embodiments, the absorbent core (7) may comprise two or more absorbent structures (13), one of which being the structure of the disclosure, and one being an absorbent structure (13) with a supporting sheet (16') with thereon an absorbent layer (17') (with superabsorbent polymer material) without channels and/or without adhesive.

If a second absorbent structure (13') is present in the absorbent core (7), this may comprise one or more adhesives, in the manner as described above, and for the reasons described above.

For example, it may be present such that it coincides with the channels (26) of the first absorbent structure (13) at least, and/ or with its channels (26'), if present.

Absorbent material (50)

The absorbent layer (17) comprises absorbent material (50) that comprises superabsorbent polymer material (e.g. particles), and is free of ~~optionally combined with~~ cellulosic material (~~including for example~~ such as cellulose, comminuted wood pulp in the form of fibers). The further material described above (e.g. a further, second absorbent structure (13') may include an absorbent material, and the following may apply thereto too.

In some embodiment, the absorbent material (50) may comprise at least 60%, or at least 70% by weight of superabsorbent polymer material~~, and at the most 40% or at the most 30% of cellulosic material.~~

In some other embodiments, the absorbent layer (17) comprises absorbent material (50) that consists substantially of absorbent polymer material, e.g. particles, ~~e.g. less than 5% by weight (of the absorbent material (50)) of cellulosic material is present;~~ and said absorbent layer (17)/ absorbent structure (13), is~~may be~~ free of cellulosic material.

disclosure the superabsorbent polymer material has a relatively narrow range of particle sizes, e.g. with the majority (e.g. at least 80%, at least 90% or even at least 95% by weight) of particles having a particle size between 50µm and 1000µm, between 100µm and 800µm, between 200µm and 600µm.

Supporting sheet (16; 16')

The absorbent structure (13) herein ~~may~~ comprises a first supporting sheet (16) on which said absorbent material (50) is supported and immobilized. The further material may be or include thea second supporting sheet (16'), and the following applies also to such a sheet (16').

This supporting sheet (16) may be an individual sheet or a web material that is subsequently divided in to individual absorbent structure (13)s, in particular paper, films, wovens or nonwovens, or laminate of any of these.

In some embodiments herein, the supporting sheet (16) is a nonwoven, e.g. a nonwoven web, such as a carded nonwoven, spunbond nonwoven or meltblown nonwoven, and including nonwoven laminates of any of these.

The fibers may be of natural or man-made origin and may be staple or continuous filaments or be formed in situ. Commercially available fibers have diameters ranging typically from less than about 0.001 mm to more than about 0.2 mm and they come in several different forms: short fibers (known as staple, or chopped), continuous single fibers (filaments or monofilaments), untwisted bundles of continuous filaments (tow), and twisted bundles of continuous filaments (yarn). The fibers may be bicomponent fibers, for example having a sheath- core arrangement, e.g. with different polymers forming the sheath and the core. Nonwoven fabrics can be formed by many processes such as meltblowing, spunbonding, solvent spinning, electrospinning, and carding. The basis weight of nonwoven fabrics is usually expressed in grams per square meter (gsm).

The nonwoven herein may be made of hydrophilic fibers; "Hydrophilic" describes fibers or surfaces of fibers, which are wettable by aqueous fluids (e.g. aqueous body fluids) deposited on these fibers. Hydrophilicity and wettability are typically defined in terms of contact angle and the strike through time of the fluids, for example through a nonwoven fabric. This is discussed in detail in the American Chemical Society publication entitled "Contact angle, wettability and adhesion", edited by Robert F. Gould (Copyright 1964). A fiber or surface of a fiber is said to be wetted by a fluid (i.e. hydrophilic) when either the contact angle between the fluid and the fiber, or its surface, is less than 90°, or when the fluid tends to spread spontaneously across the surface

CLAIMS

1. An absorbent article comprising a topsheet, a backsheet, an absorbent core disposed between the topsheet and the backsheet, characterized in that the absorbent core comprises a first supporting sheet (16), a second supporting sheet (16') and an absorbent layer (17) comprising an absorbent material (50) that comprises superabsorbent polymer material and is free of cellulosic material; wherein the absorbent layer comprises channels that are substantially free of the superabsorbent polymer material; wherein the first supporting sheet and the second supporting sheet are bonded through the channels, and wherein graphics are printed on the backsheet and the graphics approximate the shape and contours of the channels.

2. The absorbent article of Claim 1, further comprising an acquisition layer disposed between the topsheet and the absorbent core.

3. The absorbent article of any preceding Claim, wherein the channels are non-linear.

4. The absorbent article of any preceding Claim, wherein the topsheet comprises embossing.

5. The absorbent article of any preceding claim, wherein the absorbent layer comprises at least a first channel and a second channel that are substantially free of superabsorbent polymer material, wherein the first and second channels extend substantially longitudinally, and wherein the first channel is present in a first longitudinal side portion of the absorbent layer (17) and the second channel is present in a second longitudinal side portion of the absorbent layer (17).

~~6. The absorbent article of any preceding claim, wherein the absorbent layer is free of cellulosic material.~~

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